

IN THE CLAIMS:

1 1. (Original) A polymer-based mirror, comprising:
2 a transparent synthetic resin substrate having an anterior surface and a posterior
3 surface;
4 a tie-bond layer formed on said anterior surface and said posterior surface of said
5 synthetic resin substrate;
6 a multi-layer surface-hardening coating formed by a single wet coating cured
7 adjacent to said tie-bond layer on said anterior surface and said posterior surface of said synthetic
8 resin substrate;
9 a reflective coating formed adjacent to one of said tie-bond layer on said posterior
10 surface of said synthetic resin substrate and said surface-hardening coating; and
11 a protective back-coat layer formed as an outer posterior surface of said mirror.

1 2. (Original) The polymer-based mirror of Claim 1, wherein the multi-layer surface-
2 hardening coating has varying amounts of $Zr(iPv)_2$ and SiO_2 from anterior substrate surface to an
3 exterior surface of the surface-hardening coating.

1 3. (Original) The polymer-based mirror of Claim 1, wherein three layers are
2 provided in the surface-hardening coating with a first layer including the exterior surface having
3 a zirconia/silica colloid concentration of approximately 75% by weight.

1 4. (Original) The polymer-based mirror of Claim 3, wherein a second layer adjacent
2 the first layer has approximately 10% by weight zirconia/silica colloid concentration.

1 5. (Original) The polymer-based mirror of Claim 4, wherein a third layer adjacent
2 the tie-bond layer has approximately 15% by weight zirconia/silica colloid concentration.

1 6. (Original) The polymer-based mirror of Claim 5, wherein the tie-bond layer is
2 cathodic chemabsorbed zirconia/silica formed in the single wet coating.

1 7. (Original) The polymer-based mirror of Claim 5, wherein the reflective coating is
2 multilayered.

1 8. (Original) The polymer-based mirror of Claim 5, wherein a total thickness of the
2 three layers is between 3 and 10 microns.

1 9. (Original) The polymer-based mirror of Claim 1, wherein the multi-layer surface-
2 hardening coating has an exterior surface of cathodic zirconia/silica colloids to provide a
3 hydrophobic coating.

1 10. (Original) The polymer-based mirror of Claim 1, wherein the multi-layer surface-
2 hardening coating has an exterior surface of anodic zirconia/silica colloids to provide a
3 hydrophilic coating.

1 11. (Original) The polymer-based mirror of Claim 1, wherein the multi-layer surface-
2 hardening coating has an exterior surface that is enabled to be one of hydrophobic and
3 hydrophilic depending on an applied pH level to the exterior surface.

1 12. (Original) A method of forming a polymer-based mirror comprising the steps of:
2 providing a synthetic resin substrate of a pre-determined configuration;
3 preparing a liquid sol-gel having a predetermined precursor concentration of
4 zirconia/silica colloid particles;
5 applying a liquid sol-gel having a predetermined precursor concentration of
6 zirconia/silica colloid particles to the synthetic resin substrate until a pre-determined thickness is
7 provided;
8 permitting the zirconia/silica colloid particles to migrate and orientate in the
9 liquid sol-gel to enable a subsequent formation of an abrasion resistant exterior coating;
10 curing the liquid sol-gel to form a solid abrasion resistant exterior coating;
11 applying a reflective layer to one side of the coated synthetic resin substrate; and
12 sealing the reflective layer.

1 13. (Original) The method of Claim 12 wherein the liquid sol-gel includes a
2 polysiloxane carrier.

1 14. (Original) The method of Claim 13 wherein the precursor zirconia/silica forms an
2 approximately 75% concentration by weight adjacent an exterior surface as a first layer.

1 15. (Original) The method of Claim 14 wherein a second layer of zirconia/silica
2 forms an approximately 10% concentration by weight adjacent the first layer.

1 16. (Original) The method of Claim 15 wherein a third layer of zirconia/silica forms
2 an approximately 15% concentration by weight between the second layer and the synthetic resin
3 substrate.

1 17. (Original) The method of Claim 16 wherein a cathodic chemabsorbed
2 zirconia/silica layer is formed between the third layer and the synthetic resin substrate.

1 18. (Original) The method of Claim 12 further including applying a predetermined
2 pH liquid solution to the exterior coating to form one of a hydrophobic and a hydrophilic surface
3 by causing the zirconia/silica particles to be one of cathodic and anodic.

1 19. (Original) The method of Claim 18 further including applying an aqueous
2 solution of approximately 20 percent by weight NaOH to the exterior coating to form a
3 hydrophilic surface.

1 20. (Original) The method of Claim 12 wherein in the step of preparing a liquid sol-
2 gel, the following sub-steps are performed comprising:

3 mixing a partial hydrolysis of tetraethoxysilane with a solution including ZrO_2
4 precursor to consume all of the water to provide a ZrO_2 doped SiO_2 solution; and

5 dispersing the ZrO_2 doped SiO_2 solution in a polysiloxane liquid carrier.

1 21. (Original) The method of Claim 12 wherein in the step of preparing a liquid sol-
2 gel, the following sub-steps are performed comprising:

3 mixing a full hydrolysis of tetramethoxysilane oligomer in water with a solution
4 including a ZrO_2 precursor in a polar solvent to provide an anatase-type ZrO_2 and

5 dispersing the anatase-type ZrO_2 solution in a polysiloxane liquid carrier.

1 22. (Original) The method of Claim 12 wherein in the step of preparing a liquid sol-
2 gel, the following sub-steps are performed comprising:

3 mixing sodium metasilicate with water at a balanced pH of 1;
4 adding zirconyl chloride while stirring;
5 emulsifying the mixture in ethanol;
6 adding hexamethylenetetramine and urea;
7 filter and wash with ethanol to form an anatase ZrO_2 sol-gel; and
8 dispersing the anatase ZrO_2 sol-gel in a polysiloxane liquid carrier.

1 23. (Original) A polymer optical component comprising:
2 a synthetic resin substrate having a first surface; and
3 a gradient zone surface-hardening coating formed on the synthetic resin substrate
4 having a higher concentration of zirconia/silica particles adjacent an exterior surface and a
5 progressively lesser concentration of zirconia/silica particles between the exterior surface and the
6 synthetic resin substrate, the zirconia/silica particles are one of a cathodic and anodic polarity
7 while providing an abrasion resistant and water resistant coating.

1 24. (Original) The polymer optical component of Claim 23 wherein the first surface
2 has a chemisorbed cathodic layer of zirconia/silica.

1 25. (Original) The polymer optical component of Claim 24, wherein three layers are
2 provided in the surface-hardening coating with a first layer including the exterior surface having
3 a zirconia/silica particle concentration of approximately 75% by weight, a second layer adjacent
4 the first layer having a zirconia/silica particle concentration of approximately 10% by weight and

5 a third layer adjacent the synthetic resin substrate having a zirconia/silica particle concentration
6 of approximately 15% by weight.

1 26. (Original) The polymer optical component of Claim 25 wherein the synthetic
2 resin substrate is transparent and a multi-layered reflective coating is provided adjacent a second
3 surface of the synthetic resin substrate to provide a mirror.

1 27. (New) The polymer optical component of Claim 22 wherein the synthetic resin
2 substrate is transparent and is configured as a window pane.

1 28. (New) A method of forming a coating on a plastic component comprising the
2 steps of:

3 providing a synthetic resin substrate of a predetermined configuration;

4 preparing a liquid sol-gel having a predetermined precursor concentration of
5 zirconia/silica colloid particles;

6 applying the liquid sol-gel having a predetermined precursor concentration of
7 zirconia/silica colloid particles to the synthetic resin substrate until a predetermined thickness is
8 provided;

9 permitting the zirconia/silica colloid particles to migrate and orientate in the
10 liquid sol-gel over a predetermined time period to enable a subsequent formation of an abrasion
11 resistant exterior coating; and

12 curing the liquid sol-gel to form a solid abrasion resistant exterior coating.

1 29. (New) The method of Claim 28 wherein the liquid sol-gel includes a
2 polysiloxane carrier.

1 30. (New) The method of Claim 29 wherein the precursor zirconia/silica forms an
2 approximately 75% concentration by weight adjacent an exterior surface as a first layer.

1 31. (New) The method of Claim 30 wherein a second layer of zirconia/silica forms
2 an approximately 10% concentration by weight adjacent the first layer.

1 32. (New) The method of Claim 31 wherein a third layer of zirconia/silica forms an
2 approximately 15% concentration by weight between the second layer and the synthetic resin
3 substrate.

1 33. (New) The method of Claim 32 wherein a cathodic chemabsorbed zirconia/silica
2 layer is formed between the third layer and the synthetic resin substrate.

1 34. (New) The method of Claim 28 further including applying a predetermined pH
2 liquid solution to the exterior coating to form one of a hydrophobic and a hydrophilic surface by
3 causing the zirconia/silica particles to be one of cathodic and anodic.

1 35. (New) The method of Claim 28 wherein in the step of preparing a liquid sol-gel,
2 the following sub-steps are performed comprising:

3 mixing a partial hydrolysis of tetraethoxysilane with a solution including ZrO_2
4 precursor to consume all of the water to provide a ZrO_2 doped SiO_2 solution; and

5 dispersing the ZrO_2 doped SiO_2 solution in a polysiloxane liquid carrier.

1 36. (New) The method of Claim 28 wherein in the step of preparing a liquid sol-gel,
2 the following sub-steps are performed comprising:

3 mixing a full hydrolysis of tetramethoxysilane oligomer in water with a solution
4 including a ZrO_2 precursor in a polar solvent to provide an anatase-type ZrO_2 ; and
5 dispersing the anatase-type ZrO_2 solution in a polysiloxane liquid carrier.

1 37. (New) The method of Claim 28 wherein in the step of preparing a liquid sol-gel,
2 the following sub-steps are performed comprising:

3 mixing sodium metasilicate with water at a balanced pH of 1;
4 adding zirconyl chloride while stirring;
5 emulsifying the mixture in ethanol;
6 adding hexamethylenetetramine and urea;
7 filter and wash with ethanol to form an anatase ZrO_2 sol-gel; and
8 dispersing the anatase ZrO_2 sol-gel in a polysiloxane liquid carrier.

1 38. (New) The method of Claim 28 further including the steps of applying a
2 reflective layer to one side of the coated synthetic resin substrate; and
3 sealing the reflective layer.